T10382 US

A Gas Generator

Technical Field

The invention relates to a gas generator comprising a housing and propellant contained in the housing, the propellant releasing, after activation, a fluid which is under pressure, and the housing having a first and a second housing part, which are movable relative to each other under pressure and form an overflow opening or fluid passage having a variable flow area depending on the pressure in the housing.

Background Art

Gas generators of the afore-mentioned type are known, for example, from US 5 951 040. These gas generators are used in vehicle occupant restraint systems, in order for example to inflate airbags or to activate belt tensioners. If a sensor establishes that unusual acceleration values are present or if it detects an accident, then the ignition of a charge takes place, whereby a fluid is released which is under pressure. The housing of the gas generator is deformable as a function of the pressure of the released fluid, the housing parts moving with respect to each other as a function of the pressure of the fluid, and freeing an overflow opening. In so doing, substantially the entire fluid flow flows through the fluid passage formed by the overflow opening. The flow area of the overflow opening increases with a rising pressure of the fluid in the housing.

Summary of the Invention

The invention is based on the problem of optimizing the outflow behaviour of such a gas generator and in particular of preventing a blocking of the fluid flow. This is achieved in a gas generator of the above type in that the first and/or the second housing part have spacing means, the spacing means being designed so that in the case of the relative movement of the housing parts with respect to each other, a minimum value of the variable flow area is maintained. In other words,

this means that the two housing parts which in the state of rest of the gas generator lie against each other in a gas-tight manner, are deformed after the activation of the gas generator so that the overflow opening is freed. The spacing means guarantee an outflow of the fluid from the gas generator, because they prevent the overflow opening from being closed again and the fluid flow from being blocked as a result of a continuing deformation of the housing parts. Thereby, at the same time a mechanically weaker construction of the housing is possible, because after activation of the gas generator, a sufficiently large flow cross-section of the overflow opening for an emergence of the generated fluid is maintained, even when the housing parts are pressed against each other by the high pressure in the gas generator.

If the first and the second housing part is constructed substantially so as to be radially symmetrical, this is particularly favourable, because then the pressure of the released fluid can act uniformly on the housing parts and thereby an excess stressing of individual housing sections is avoided.

Preferably, the first and the second housing parts form a substantially ring-shaped over-flow opening, because in this case a uniform outflow of the released fluid from the gas generator into the vehicle occupant restaint system is made possible.

It is also particularly favourable when the first and the second housing parts form a common first contact region before the activation of the propellant, the common first contact region being additionally secured with an adhesive connection. The adhesive connection guarantees an even higher gas-tightness of the gas generator housing in the state of rest. Thereby, the penetration of humidity or other substances having an unfavourable effect on the function of the gas generator is avoided.

In a preferred embodiment, the spacing means are constructed as corrugations or beads. These can be worked in a particularly simple manner into the housing parts and, moreover, ensure a further reinforcement of the component. The

generated fluid can then emerge from the housing through sections of the overflow opening formed in the region between the corrugations or beads. Here, the first housing part can be a cover which closes off the second housing part, for example a combustion chamber wall. The corrugations or beads are then preferably arranged in a region of the cover which is adjacent to the first contact region between cover and second housing part.

Additionally preferred is an embodiment in which the spacing means are constructed as grooves or as ribs lying adjacent to the first and/or second housing part. The grooves can be produced in a simple and favourably-priced manner by milling on one of the housing parts; the ribs can be connected very easily with one of the housing parts, e.g. by welding, or formed in another manner.

The invention further comprises a gas generator of the type initially mentioned in that between the first and the second housing part, spacing means are provided, the spacing means being separate from the first and second housing part and designed so that in the case of the relative movement of the housing parts with respect to each other, a minimum value of the variable flow cross-section or flow area is maintained. This means that the two housing parts which lie adjacent to each other in a gas-tight manner in the state of rest of the gas generator, are deformed after the activation of the gas generator so that the overflow opening or fluid passage is freed. The spacing means guarantee an outflow of the fluid out from the gas generator, because they prevent the overflow opening being closed again and the fluid stream being blocked as a result of a further deformation of the housing parts. Therefore, at the same time, a mechanically weaker construction of the housing is possible, because after activation of the gas generator, a sufficiently large flow cross-section of the overflow opening is maintained for an emergence of the generated fluid, even if the housing parts are pressed against each other by the high pressure in the gas generator.

If the first and second housing part are constructed substantially radially symmetrically, then this is particular favourable, because then the pressure of the

released fluid can act uniformly on the housing parts and therefore an over-stressing of individual housing sections is avoided.

Preferably, the first and second housing part and also the spacing means form a substantially ring-shaped overflow opening, because in this case a uniform outflow of the released fluid is made possible out from the gas generator into the vehicle occupant restraint system.

It is also particularly favourable if the first and the second housing part form a common first contact region before the activation of the propellant, the common first contact region being additionally secured with an adhesive connection. The adhesive connection guarantees an even higher gas-tightness of the gas generator housing in the state of rest. Therefore, the penetration of moisture or other substances having an unfavourable effect on the function of the gas generator is avoided.

In preferred embodiments, the spacing means have an L-shaped or half-ring – shaped cross-sectional profile. Spacing means of this shape can be produced in a particularly simple manner and ensure, moreover, a further reinforcement of the component. The generated fluid can then emerge out from the housing through several opening sections, separated from each other, of the overflow opening.

Brief Description of the Drawings

Further features and advantages of the invention will be apparent from the following description of preferred embodiments with reference to the accompanying drawings, in which:

- Figure 1 shows a gas generator according to the invention;

- Figure 2 shows a sectional view of a housing of a gas generator according to the prior art;

- Figure 3 shows in a first embodiment of the invention a sectional view of the housing of the gas generator of Figure 1 with activated gas generator;

- Figure 4 shows a top view onto the gas generator of the first embodiment;

- Figure 5 shows a perspective view of the housing of the gas generator of the first embodiment;

- Figure 6 shows a perspective view of a second embodiment of the housing of the gas generator;

- Figure 7 shows a sectional view of the second embodiment of the housing of the gas generator;

- Figure 8 shows a perspective view of a third embodiment of the housing of the gas generator;

- Figure 9 shows a sectional view of the third embodiment of the housing of the gas generator;

- Figure 10 shows a sectional view of a fourth embodiment of a gas generator according to the invention;

- Figure 11 shows a sectional view of a fifth embodiment of a gas generator according to the invention;

- Figure 12 shows a sectional view of a sixth embodiment of a gas generator according to the invention; and

- Figure 13 shows a top view of the spacing means of a gas generator according to the invention.

Description of Preferred Embodiments

In the figures, a gas generator 10 is shown, which corresponds in structure and function substantially to the gas generator described in the US 5 951 040, incorporated herewith by reference. In the following description parts performing the same function are referred to with the same reference numerals.

Figure 1 shows a gas generator 10 with a central igniter chamber 12, in which here two igniters 14 are arranged. Alternatively, the igniter chamber 12 can also have only one igniter. The igniter chamber 12 is surrounded by an inner wall 15, in which channels 16 are situated, only one of which is illustrated here. The channels 16 provide a connection between the igniter chamber 12 and an outer combustion chamber 18. The igniter chamber 12 and the outer chamber 18 each contain a propellant (not illustrated). The inner wall 15 is connected with an igniter flange 19, in which the igniters 14 are fastened. The igniters 14 and the chambers 12, 18 are surrounded by a multiple-part housing 20.

The housing 20 is constructed substantially from three housing parts 22, 24, 26.

The first bell-shaped housing part 22 comprises a cover section 28, a wall section 30 delimiting the generator peripherally with gas outlet openings 32, and a flange section 34, which can serve for fastening the gas generator to a generator supporting part (not illustrated). In the transition region between the cover section 28 and wall section 30 of the first housing part 22, beads or corrugations 44 are formed as spacer elements, which extend into the interior of the housing. In a variant (not illustrated), the corrugations 44 can be also be constructed towards the exterior.

The second housing part 24 is substantially a cylinder ring which delimits the combustion chamber 18 peripherally. At its end facing the first housing part, the second housing part 24 forms an end section 36, which lies in a first contact region 38 tightly against the cover section 28. The connection between the end section 36 and the cover section 28 is further secured by an adhesive connection. Between the wall section of the first housing part 22 and the second housing part 24, an outflow region 39 is situated, through which a fluid connection is produced from the chambers 12, 18 to the gas outlet openings 32.

The third housing part 26 likewise has a cylindrical wall section 40 and a radially extending base section 42. The wall section 40 of the third housing part is

arranged between the wall section 30 of the first housing part and the second housing part 24 and firmly bonded to the wall section 30. The base section 42 forms a part of the underside of the gas generator 10 and holds the igniter flange 19 with the igniters 14.

In Figure 2 the housing 20 of a gas generator is illustrated according to the prior art, with the housing parts 22, 24, 26 enlarged, in two different positions (Position I = dashed line, Position II = continuous line), the significance of which is explained further below.

Figure 3 shows an enlarged cutout of the housing 20 with the three housing parts 22, 24, 26 according to the invention. The position of the end section 36 of the second housing part 24 corresponds here to that of position II in Figure 2. The end section 36, however, only lies partially, with the formation of second contact regions 38', against the corrugations or beads 44 on the cover section 28. Between the second contact regions 38', an overflow opening 46 is constructed with opening sections 46a, through which the outer chamber 18 and the outflow region 39 are in fluid connection with each other, as symbolized by the arrow A.

In the embodiment (not illustrated) having the outwardly constructed corrugations 44, a contact between the end section 36 and the cover section 28 only exists in the second contact regions 38'. The overflow opening 46 with the opening sections 46a, through which the outer chamber 18 and the outflow region 39 are in fluid connection with each other, is constructed between the second contact regions 38'.

The construction of the corrugations or beads is shown in detail in Figures 4 and 5. In each case one bead 44 (see Figure 5) is arranged here in the transition region between cover section 28 and wall section 30 of the first housing part 22 between two gas outlet openings 32, respectively.

The mode of operation of the first embodiment of the gas generator is to be illustrated hereinbelow.

In Figure 2 the initial positions I of the housing parts 22, 24, 26 of the inactive gas generator are shown in dashed lines. This position is the same both in prior art gas generators and gas generators of the invention. On igniting of one or two of the igniters 14, the pressure in the igniter chamber 12 increases very sharply and by means of mechanical transmission means (not illustrated), the cover section 28 of the first housing part 22 is raised, the adhesive connection being detached (see Figure 2, Position II). At the same time, the gas released from combustion of the ignition composition flows via the channels 16 into the outer chamber 18 and activates a combustion of the propellant in the chamber 18. By the high pressure in the outer chamber 18, however, the second housing part 24 and in particular the end section 36 can be displaced radially outwards into the transition region between cover section 28 and wall section 30, particularly when the wall thickness thereof is constructed too small. The position reached after this displacement is marked by II in Figure 2. In gas generators according to the prior art (Figure 2), after the activation of the gas generator, a blocking of the overflow opening can therefore occur between the first housing part 22 and the second housing part 24, and the emergence of gas from the gas generator can be prevented.

In the gas generator according to the invention, as can be seen in Figure 3, the end section 36 of the second housing part 24 after activation of the gas generator is likewise displaced into the transition region between cover section 28 and wall section 30; through the construction of the corrugations or beads 44, the end section 36, however, only lies partially against the cover section 28 and ensures that a minimum value of a flow area is maintained. Thereby it is ensured that released gas can pass over from the outer chamber 18 through the overflow opening 46 in arrow direction A into the outflow region 39, in order to then be able to leave the gas generator via the gas outlet openings 32 and flow into an airbag or into another vehicle occupant protection device (not illustrated).

In Figures 6 and 7 a second embodiment of the invention is illustrated. The second housing part 24 has grooves 48 here in the region of the end section 36 on an outer wall 47.

In the state of rest before the activation of the gas generator, the end section 36 lies in a gas-tight connection against the cover section 28 (cf. Position I in Figure 2). With regard to the function of the gas generator, up to the displacement of the end section 36 of the second housing part 24 into the transition region between cover section 28 and wall section 30 (Position II in Figure 2), reference is to be made to the statements regarding the first embodiment. Because of the grooves 48, the end section 36 in Position II lies against the cover section 28 only in the second contact regions 38'. Released gas can flow out from the outer chamber 18 through the overflow opening 46 in arrow direction A into the outflow region 39 and then reaches the gas outlet openings 32 of the gas generator.

In the third embodiment illustrated in Figures 8 and 9, short ribs 50, spaced apart from each other, are constructed on the outer wall 47 of the second housing part 24 in the region of the end section 36. As an alternative to this, the ribs may also be constructed as insert components to be placed in the transition region between the cover section and wall section of the first housing part.

Also in this embodiment, the end section 36 in the state of rest before the activation of the gas generator lies in a gas-tight connection against the cover section 28 (see Position I in Figure 2). With regard to function in the initial phase after the activation of the gas generator, reference is likewise to be made to the description of the first embodiment. In the third embodiment, the end section 36, after activation of the gas generator, lies with the ribs 50 in the second contact regions 38' against the transition region between cover section 28 and wall section 30. The open regions between the ribs 50 make it possible for gas for be able to flow from the outer chamber 18 through the overflow opening 46 in arrow direction A via the outflow region 39 reliably to the gas outlet openings 32.

In figures 10 to 12 further embodiments of the invention are illustrated.

Figures 10 to 12 essentially show the gas generator 10 of Figure 1. Additionally, above one of the igniters 14, a cap 13 is arranged which is displaceable on the inner wall 15.

Furthermore, between the first housing part 22 and the second housing part 24 there is situated respectively in the various embodiments a spacing means 52, 56, 60 which is to be described in further detail below.

The spacing means of the embodiment of Figure 10 is a cylindrical ring 52 with a substantially rectangular cross-sectional profile. As can be seen in the view onto the cylindrical ring 52 (Figure 13), the latter has over its entire periphery on its outer side equidistant recesses or grooves 53 which have substantially a semicircular cross-section. Between two grooves 53 respectively a cross-piece or tooth 54 is formed. The cross-pieces 54 lie against the first housing part 22.

The spacing means of the embodiment shown in Figure 11 is a ring 56 with an L-shaped cross-sectional profile. The ring 56 with L-shaped cross-sectional profile, like the cylindrical ring 52, is provided on its radially outwardly extending end with grooves 57, between which respectively cross-pieces or teeth 58 are situated, which are in contact with the first housing part 22. The ring 56 with L-shaped cross-sectional profile lies at its axially extending lower end on the wall section 40 of the third housing part 26, whereby an as a whole particularly stable bearing of the ring 56 with L-shaped cross-sectional profile is achieved on the housing parts 22, 24, 26 of the gas generator 10.

The spacing means can be further constructed as forms or ring 60 with semicircular cross-sectional profile and grooves 61 with cross-pieces or bridges 62 lying therebetween (Figure 12). The cross-pieces 62 lie against the first housing part 22.

In the following, the mode of operation of the fourth, fifth and sixth embodiment of the gas generator is to be illustrated:

In the gas generator according to the fourth to sixth embodiment of the invention, the end section 36 of the second housing part 24, after activation of the gas generator, is likewise displaced into the transition region between cover section 28 and wall section 30. Through the construction of the grooves 53, 57, 61 and cross-pieces 54, 58, 62, the spacing means 52, 56, 60, however, only lies

Through the grooves 53, 57, 61 an overflow opening or fluid passage with several opening sections is formed, and it is thus ensured that a minimum value of a flow area is maintained. Thereby, it is ensured that released gas can pass from the outer chamber 18 through the grooves 53, 57, 61 into the outflow region 39, in order to then be able to leave the gas generator via the gas outlet openings 32 and flow into an airbag or into another vehicle occupant protection device (not illustrated).